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# ***Interactive comment on “Decadal variability of heat content in South China Sea inferred from observation data and an ocean data assimilation product” by W. Song et al.***

## **Anonymous Referee #1**

Received and published: 23 September 2013

Review of

Decadal variability of heat content in [the] South China Sea inferred from observation data and an ocean data assimilation product

by

W. Song, J. Lan, Q. Liu, and D. Wang

General Comments

In this paper the authors consider the contributions of surface fluxes and ocean heat advection to the change in upper ocean heat content in the South China Sea. To do

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this they use data from an ocean data assimilation (SODA) and surface fluxes from an atmospheric reanalysis (NCEP). During the timeframe 1958-2003 they identify four periods in which the heat content of the South China Sea decreases, increases, decreases and finally increases again. Furthermore they find that in the first two periods, up to 1981, advection dominates the heat content change while in the second two periods, from 1982 onwards, surface fluxes are the principal cause of heat content change.

As such the article is interesting and worth publication. It is however rather concise and laced with abbreviations rather than writing out the concepts in full, so that its readability is weakened. Moreover the paper needs to be written in a more self-contained way, so that readers do not necessarily need to read all the references to understand what has been done.

So far as I can see the XBT data is only used to compare it to the SODA results, which presumably contain the XBT data anyway. One important question is whether these data have been corrected for the well-known problem with XBT data in the 1970s when an error in the equation linking the depth to the falling time led to errors in the temperature-depth relationship and hence errors in heat content. Another important question relates to the spatial distribution of data within the region. Over the timeframe in question political interests in the region have changed considerably and this may have affected the spatial distribution of data collection.

The introduction contains some assertions not supported by references, for example p1331, lines 7-8.

In the Methods section on p1332 there needs to be more detail of the budget equation. In particular to distinguish between horizontal and vertical advection and horizontal and vertical diffusion, so that it is clear what is contained in the each of the terms in what I presume is the budget equation:

$$HCC = QNET + ADV + R,$$

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which also needs to be explicitly written somewhere so that we know what the signs of the terms are, rather than guessing them from Table 1.

I presume the heat content is the integral of the Celsius temperatures over the top 400 m multiplied by the density and specific heat, but this needs to be said. Admittedly only anomalies and changes are discussed, so that the reference temperature (zero Celsius) is arbitrary. Since XBTs usually reach 700 m depth I wonder why the authors only used 400 m?

Also it says that the “climatological[ly] seasonal cycle is removed”. The authors need to state how this was done, as there are good and bad ways of doing this.

On p1333, line 3 etc, a comparison between the XBT data and the SODA reanalysis is described. If SODA contains the XBT data, then this is superfluous, otherwise more detail needs to be shown, including a map to show where the 9 boxes were and diagrams to show how well the heat contents compare.

On p1334, lines 5-7, presumably what the authors mean is that the heat content increase from 1992 to 2003 was more than twice the heat content loss from 1982 to 1992.

When discussing the spatial differences on p1334 the features described should be quantified.

In order to explain their interesting finding the authors should consider changes in the atmospheric circulation as a possible explanation for the result.

#### Specific Comments

p1332,, ll 3-4: “below” and “above” should be written “deeper than” and “shallower than” to be completely unambiguous.

p1332, l 25: “...likely to be related to...”

p1333, l 11: “...studying the heat budget...”

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p1333, l 26: “variance” should probably be “change”.

p1338, Table 1: Does  $HCC = QNET + ADV + R$ ? Please include this. Is there any idea what the errors in these numbers are?

p1340, Fig.2: The correct units for temperature differences, temperature changes and anomalies is K. The bottom panel is presumably heat content (and not heat content change, p1333, line 10). The text (p1333) line 5 says it is an example, line 10 says it is the South China Sea. What are the units? To what is the anomaly relative? Any arbitrary reference level? The long term mean? If it is a restricted area, then where?

P1342, Fig.4: What are the units? The same scale for each panel and a zero-line would help.

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Interactive comment on Ocean Sci. Discuss., 10, 1329, 2013.

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